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PAPERS READ

BEFORE THE

ROYAL GEOGRAPHICAL SOCIETY.

I.—*On the Stade, as a Linear Measure.* By W. MARTIN LEAKE, Esq. Read 26th November, 1838.

§ 1. SOME modern geographers have supposed that the ancients, in computations of distance, employed stades of different lengths, varying in the number contained in a degree of latitude from 500 to 750.[*] By means of this variety, they have endeavoured to reconcile the conflicting statements of the ancient mathematicians as to the measure of the perimeter of the globe, as well as to explain the disagreements which, on the supposition of an uniform stade, continually occur in applying ancient distances to true measurements on a globe or map. An attentive examination, however, of all the evidence which may be derived on this question from ancient authors or extant monuments, justifies the opinion that the stade, as a linear measure, had but one standard, namely, the length of the foot-race, or interval between the ἀφετηρία and καμπτῆρ in all the stadia of Greece, and which is very clearly defined as having consisted of 600 Greek feet.[†]

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[*] D'Anville, Mesures Itinéraires, vi. p. 69.—Gosselin, Géographie des Grecs Analysée.—Recherches sur la Géographie Systématique et Positive des Anciens.—Géographie de Strabon, i., Observations Préliminaires, v. p. 501.—Romé de l'Isle, Métrologie; Paris, 4to., 1789.—Freret, Mém. de l'Acad. des Inscr. xiv., 1ère partie, p. 160; xxiv. p. 432, 548.—D'Anville, *ib.*, xxvi. p. 82, 92; xxviii. p. 346; xxxi. p. 292.—Delabarre, *ib.*, xiv., 1ère partie, p. 512; xix. p. 533, 547, 562.—De la Nauze, *ib.*, xxvi. p. 101; xxviii. p. 362; xxxvi. p. 86.—Gibert, *ib.*, xxviii. p. 212.—Jomard, Mém. sur le Système Métrique des Anciens E'gyptiens. Description de l'Egypte, vii. p. 8.——In France, the hypothesis was not without opponents, as Montucla, Hist. de Math. i. p. 241. In Germany, Ukert on the Geography of the Greeks and Romans, i. sec. 3, may be particularly referred to.

[†] Αἱ δ' ἑκατὸν ὀργυιαὶ δίκαιαί εἰσι σταδιον ἑξάπλεθρον, ἑξαπέδου μὲν τῆς ὀργυιῆς μετρεομένης καὶ τετραπήχεος· τῶν πόδων μὲν τετραπαλαίστων ἐόντων, τοῦ δὲ πήχεος ἑξαπαλαίστου. Herodot. 2, 149.——See also Strabo, p. 322.—J. Poll. iii.—Suid. in Μίλιον, Πλέθρον, Στάδιον.—Phot. Lex. in Πλέθρον Στάδιον.—Eustath. in Il. H. 240.

Herodotus has mixed the Greek measures with the Egyptian, and has added also the parasang: whence it would seem that the inhabitants of Lower Egypt, where many Greeks were then settled, had in his time borrowed the stade and its subdivisions from the Greeks, and that the parasang had been adopted during their subjection to the Persians. The only proper Egyptian measures, with which we are acquainted, are the schœnus of 24,000 cubits, and the cubit divided into 28 digits.

The Attic foot, taken from the stylobate of the Parthenon, was equal to 12·1375 English inches:[*] the length of the stade, therefore, in English measure, was 606·875 feet. The stade was generally considered equal to one-eighth of the Roman mile,[†] or 625 Roman feet,[‡] the mile having been 5000 of those feet. The Roman foot, taken from extant Roman monuments, was 11·6 English inches; [§] deduced from the Greek foot of the Parthenon, in the proportion of 625 to 600, or 25 to 24, it was 11·652 inches. By the former proportion, the Roman mile was equal to 4833 English feet, or 22 feet less than 8 stades: thus perfectly agreeing with Plutarch, who informs us that the mile was something less than 8 stades.[||] And hence it seems evident that the Greek stade contained something more than 625 Roman feet. Indeed, when it is considered that the stade was a measure foreign to the Romans, and was composed of a foot different from theirs in length, there was little chance of its having been an exact fraction of a mile, though the accidental proximity was probably the origin of the furlong or eighth, as a division of the mile.

Results so nearly coinciding, though drawn from monuments and authorities, between the dates of which there was an interval of six centuries, tend strongly to show the accuracy, permanence, and uniformity of Greek measures—of which we have a parallel instance in the Attic weights, particularly as exemplified in ten or twelve denominations of silver money, of which the standard continued to be correctly preserved during at least seven centuries. An accurate standard of the foot was obviously not less necessary to the Greeks than that of the drachma; or rather it was a natural consequence of the perfection, to which they attained in architecture and other arts, founded on metrical principles. For the standard of the stade as a measure of distance the stadium of every large city furnished a constant and easy reference, and thus tended to keep the measure accurate and uniform: for there can be little doubt that whatever difference there may have been in the construction of stadia as places of assembly, the length of the foot-race—that contest which gave immortality to the victor, and for which competitors were periodically collected from every country of Greek origin, at Olympia, the Isthmus, Nemea, and Delphi, as long as the four sacred games continued—was invariably the same throughout Greece.* This indeed is strongly confirmed by many stadia still extant in Greece; and hence undoubtedly arose, in the progress of Greek civilisation, the general use, as a linear measure, of this multiple of the natural measures taken from the human body, which were the earliest in all countries. As the stade could not have been introduced into common use as a measure, until long after the establishment of the sacred games, we are not surprised to find, even so late as the time of Herodotus, traces of the earlier custom of describing distances in the ὀργυιὰ, or fathom, the longest of the Greek measures before the stade was introduced.

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[*] Stuart's Ant. of Athens, ii. p. 35. Ed. Kinnaird.

[†] Λογιζομένω δὲ ὡς μὲν οἱ πολλοὶ τὸ μίλιον ὀκτωστάδιον. Strabo, p. 322.—Polyb. 3, 39.—Dionys. Hal. iii.—Appian, .—Vitruv. 1. 6.—Columel. 5, 1.—Plin. H. N. 2, 63 (108).—Frontin. de Expos. form. ap. rei agr. Script., Goes. p. 30.—See also an Anonymus in the collection of Goes.—Marcian, Heracl. ap. Geogr. Gr. Min., Hudson. Livy constantly converts the stades of Polybius into miles at this rate. Compare Polyb. 3, 42; Liv. 21. 28—Polyb. 3. 101; Liv. 25. 9—Polyb. 14, 4; Liv. 30, 5—Polyb. 14, 8—Liv. 30, 8. Strabo, in testifying that eight stades were equal to a Roman mile, asserts that Polybius added two plethra, or a third of a stade (Πολύβιος, προστιθεὶς τῷ ὀκτωσταδίῳ δίπλεθρον, ὅ ἐστὶ τρίτον σταδίου, p. 322); but this is contrary to the testimony of Polybius himself, who describes a great road through Spain and France as divided into miles of eight stades each (ταῦτα μὲν βεβημάτισται καὶ σεσημείωτας κατὰ σταδίους ὀκτὼ διὰ Ῥωμαίων ἐπιμελῶς, 3, 39). Strabo, therefore, seems to have understood Polybius, who perhaps meant only to say that a Roman stade, or measure of 600 Roman feet, would require $8\frac{1}{3}$ of them to the mile; for $8\frac{1}{3}$ to 8, or 25 to 24, is exactly the proportion of the Greek foot to the Roman, as given by Pliny.

[‡] Stadium centum viginti quinque nostros efficit passus, hoc est, pedes sexcentos viginti quinque. Plin. H. N. 2, 21 (23).

[§] Folkes (in the Philosophical Transactions, anno 1736) concluded $\frac{966}{1000}$ of the English feet, or 11·592 inches, to have been the length of the Roman foot.—Raper, Phil. Trans. 1760) 11·64 in the time of Titus, and 11·58 in that of Alexander Severus. The average of these, 11·6 does not differ a fiftieth part of an inch from that of numerous measurements made by the French. See Gosselin, Géogr. de Strabon, i. p. lxi.—Ukert, 1. sec. 2.

[||] τὸ δὲ μίλιον ὀκτὼ σταδίων ὀλίγον ἀποδεῖ. Plutarch, C. Grac. 7. Caius Gracchus caused mile-stones to be erected on the great roads of Italy, as well as other stones at short intervals on each side of the road, that horsemen might mount their horses without the assistance which had before been necessary (ἀναβόλεως μὴ δεομένοις.)

These observations refer chiefly to European Hellas. We have no information as to the gymnastic and agonistic customs of the Greek cities of Asia prior to the Roman, or at least to the Macedonian conquest—or even whether there were at an earlier time any stadia in the Asiatic Greek cities for those purposes, which had such a powerful influence on the manners and character of the people of European Greece. To this side of the Ægæan, at least, the great games which maintained the integrity of the European Greek stade were confined, until, on the other side, Persia had yielded to Macedonia.

The only clear indication which ancient history affords of a difference of standard between the Asiatic and European Greek foot is found in Herodotus, who remarks that the Egyptian cubit was equal to the Samian.[*] Now the average of four Memphite cubits found in Egypt, and very slightly differing, is $20\frac{6}{10}$ English inches.[†] The Samian foot, therefore, was $13\frac{3}{4}$ English inches; and a stade composed of this foot would be 687 English feet in length. Herodotus remarks that the royal cubit of Assyria was three digits, or one-eighth, greater than the *πῆχυς μέτριος*,[‡] or ordinary cubit of a Greek foot and a half, and equal consequently to 20·482 English inches, differing very slightly from the Memphite cubit. A stade composed of 400 of these cubits would have been 683 English feet. Heron of Alexandria, a writer of the fifth century of our era, who has supplied us with a table of Greek measures of his own time, together with others which he calls ancient, places among the latter the Philetærian stade, formed of 600 Philetærian or royal feet, which bore to the Italian the proportion of 18 to 15.[§] The name Philetærian tends to the belief that this foot was in use at Pergamus; which, having been the most illustrious and powerful city in Asia for two or three centuries after it had become the capital of a kingdom,[||] may have brought into use in the surrounding part of Asia a foot of a particular standard, together with its multiples. If so, the Pergamenian was somewhat longer than the Samian foot, and its stade was 697 English feet. Whether these proportions are exact or not, we may at least conclude that the foot or cubit of Egypt and Asia was longer by about a tenth than that of European Greece; and hence it is possible that, under the Macedonian monarchies of Egypt and Asia, a stade bearing about that proportion to the stade of Greece may have been employed in those countries. There is some reason to believe that this was really the case in Asia Minor, as stadia still exist in that country, as at Aphrodisias and Laodiceia, of which it is difficult to conceive that the curriculum was not considerably longer than in the stadia of Greece Proper. These, however, are the utmost variety of stades, for which any support can be found in ancient history prior to the third century of the Christian era; and one only of these, besides the European Greek stade—namely, the Samian—can be supposed to have been in use before the time of Alexander the Great. Taking the French measurement of the perimeter of the globe, upon which the length of their metre was founded, and which gives 364,538 English feet to the degree, the stade of 600 Greek feet was a little more than the 600th part of a degree, the Babylonian was the 534th, the Samian the 530th, and the Pergamenian the 523rd.

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* It requires better evidence than the tale related by Aulus Gellius (l. 1.) on the pretended authorities of Plutarch and Pythagoras, and which seems to have been invented in illustration of the proverb, 'ex pede Herculem,' to prove that the Olympic stadium was really larger than the others; for, had the foot of Hercules been only one inch longer than that of other men, it would have made a difference of 50 feet in the curriculum of the stadium.

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[*] Herodot. 2, 168.

[†] Jomard, Lettre à Remusat sur une nouvelle mesure de coudée; 4to. Paris, 1807.

[‡] Herodot. 1, 178.

[§] Montfaucon, Palæog. Græc. p. 365.—Mém. de l'Acad. des Sciences, vii. p. 23. 318.

[||] 'Longè clarissimum Asiæ Pergamum;' the acquisition of which, says Pliny, more affected the manners of Rome than that of any other Greek city, as the Pergamenians were equally renowned for their libraries and their cock-fighting. In the time of Pliny Pergamus was the centre of an extensive jurisdiction.—Plin. H. N. 10, 21 (25).

The hypothesis, however, of the celebrated French geographers referred to at the beginning of this Paper, requires a much greater variety of stades, and it requires stades which in one instance only, that of 600, bear the same proportion to the degree as any of those above mentioned. D'Anville annexed to the Map of his Ancient Atlas the scales of four different stades: the Aristotelian of about 1110 to the degree;—a stade of 60 to the Egyptian schœnus, differing not greatly from the former;—the Olympic of 8 to the Roman mile;—and a nautical stade of 10 to the same mile. Romé de l'Isle imagined 8, and Gosselin 9 different kinds of stade, derived from various ancient computations of the perimeter of the globe in stades; these were 400000, 360000, 300000, 270000, 252000, 240000, 225000, 216000, 180000; giving respectively to the degree of latitude the following number of stades, 1111$\frac{1}{9}$, 1000, 833$\frac{1}{3}$, 750, 700, 666$\frac{2}{3}$, 625, 600, 500.* The whole principle of this hypothesis is comprehended in the words of Jomard: "Le module diffère, l'unité est la même;"† that is to say, it was imagined that an unknown people of the highest skill in astronomy and geography had made a true measurement of the perimeter of the globe; that the Greek geographers had expressed it in stades of different lengths; that from the proportion of the several computations of the perimeter to each other, the rate of each kind of stade to the degree may be recovered; and that by the application of some one of them, many of the distances mentioned by ancient authors, which are apparently incongruous and false, may be reconciled with the truth. In this manner the ancients will undoubtedly appear to have made a much greater progress in accurate geography than can otherwise be imagined. There is strong reason to believe, however, that their conflicting estimates of the circumference of the globe had a very different origin.

§ 2. The most ancient computation of the perimeter appears to have been that of 400000 stades,‡ and to have been adopted by Thales and Anaximander. By what method this estimate was obtained we have no positive evidence; but we may presume that the ancient mathematicians alluded to by Aristotle proceeded in the same manner as Eratosthenes, by endeavouring to compare the terrestrial distance between two places, situated under the same meridian, with their interval in parts of the great circle, this being in fact the only mode of connecting geometry with astronomy. The ancients had never any better means of obtaining the proportion of the arch to the whole circle, than by observing the proportion between the length of the gnomon and its shadow: but in this manner, as the instruments which they employed were rendered more perfect, differences of latitude might be ascertained with an increasing approach to accuracy. The terrestrial measurement was of greater uncertainty: indeed the difficulty which modern experience has shown to attend this simple operation, so as to render it worthy of confidence as a basis of geometrical calculation, is alone sufficient to account for all the discordant results of the ancient attempts to measure an arc of the meridian.

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* Gosselin, Géographie de Strabon, i. p. 1; v. p. 500.

† Mém. sur le Système Métrique des Anciens E'gyptiens. Description de l'E'gypte, vii. octavo, p. 183.

‡ Aristot. de Cœlo, 214.

The method by which Eratosthenes obtained the perimeter of the globe in stades is recorded by Cleomedes.* Having assumed Syene to have been on the extreme limit of the tropical line, where the gnomon gives no shadow on the longest day, and Alexandria to be under the same meridian as Syene, at a distance of 5000 stades, Eratosthenes observed, and with a near approach to the truth, that at Alexandria the gnomon on the longest day covered one-fiftieth part of the circle. Five thousand stades, therefore, he inferred to be the fiftieth part of the circumference of the globe, and 250000 stades to be its perimeter. About 30 years later, Hipparchus is said to have augmented the computation of Eratosthenes to something less than 277000 stades, but upon what ground, Pliny, the only writer who alludes to the fact, has not informed us:† indeed it is virtually contradicted by Strabo, who informs us that Hipparchus employed the proportion of 700 stades to the 360th part of the great circle, making a perimeter of 252000 stades, and that he attempted to determine the celestial phenomena appertaining to each of these degrees.‡

In another calculation mentioned by Cleomedes, but without naming its author, the distance between Syene and Lysimachia in the Thracian Chersonesus, was assumed to be a fifteenth part of the circle, and their terrestrial distance to be 20000 stades, giving for the entire circle 300000 stades. This measurement is no otherwise deserving of attention, than as having been adopted by Archimedes,§ for the difference of latitude between the two places instead of being a fifteenth, was little more than the twenty-second part of the great circle. Another attempt to estimate the circumference of the earth was made, about a century after the time of Eratosthenes, by Posidonius, who, employing the same kind of process as Eratosthenes, determined the perimeter to have been 240000 stades,[*] which gives a rate of 666⅔ stades to the degree; but afterwards reduced that number to three-fourths or 180000, which gives 500 stades to the degree.[†] The arc of the meridian employed by him was that between Rhodes and Alexandria; which places he, as well as Eratosthenes, erroneously believed to be under the same meridian, at a distance which he reckoned at first 5000 stades, but afterwards reduced to 3750, and consequently the perimeter in the same proportion, nearly of 4 to 3. This number 3750, however, Posidonius derived from Eratosthenes himself, who having obtained the difference of latitude between Alexandria and Rhodes by gnomonic observations,[‡] had converted it into stades at the rate which he had obtained in Egypt from a comparison of 5000 stades with the difference of latitude between Syene and Alexandria. Both these computations of Posidonius, therefore, were nothing better than unsuccessful endeavours to improve upon Eratosthenes. In the second calculation, by diminishing his distance in stades, without correcting his difference of latitude, which instead of a fiftieth is about a sixty-eighth part of the circle, he was still farther from Eratosthenes in defect, than he had before been in excess.[§]

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* Cleomed. Meteor. 1, 10.

† Plin. H. N. 2, 108 (112).

‡ Strabo, p. 62, 131.

§ Archimed. in Arenar. p. 277.

All the geographers of later date, or at least until the second century of our æra, were satisfied with the computation of Eratosthenes,[||] which had the merit of proceeding on a correct assumption of the difference of latitude. Pliny speaks of it in terms which show that it still maintained its authority in his time.[¶]

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[*] Ap. Cleomed. Meteor. 1. 10.

[†] Strab. p. 95.

[‡] *αὐτὸς δὲ διὰ τῶν σκιοθηρικῶν γνωμόνων ἀνευρεῖν τρισχιλίους ἑπτακοσίους πεντήκοντα.* Eratosth. ap. Strabon, p. 126. Pliny also says (H. N. 5, 31 (36), Rhodos distat ab Alexandriâ Ægypti, ut Eratosthenes tradit cccclxix M.P. Which, according to the proportion invariably observed by Pliny between the stade and the mile, was 3752 stades.

[§] There were other reports of the distance between Alexandria and Rhodes. Isidorus made it 578 M.P., or 4624 stades; and Marcianus 500 M.P., or 4000 stades (Plin, l. l.). Nothing can better show the uncertainty of ancient geography than such disagreements regarding one of the most important lines in the ancient maps, and which the geographers could not have failed to have agreed upon, at least within a much smaller difference, if the ancients had possessed even any such rough mode of calculating the run of a ship as the modern log. It is curious that all the ancient computations are wide of the proportion required by the stade of 600 Greek feet, or 600 stades to the degree. By this measure the true distance between Alexandria and Rhodes is about 3250 stades.

[||] Strab. p. 113, 132.—Plin. H. N. 2, 108 (112).—Vitruv. 1, 6.—Macrob. Somn. Scip. 1, 20;—2, 6.—Eratosth. al. Hipparch. ad Arat. Phænom. 2, in fin. ap. Petav. Uranol. p. 144.—Gemin. Elem. Astron. 13, ap. Petav. Uranol. p. 30.—Censorin. de die nat. 13.—Martian. Capel. de Geom. 6, p. 194, Lugd. Bat., 1599.

[¶] Improbum ausum, verùm ita subtili argumentatione comprehensum ut pudeat non credere, H. N. 2, 108 (112). Marcian of Heracleia, however, says (p. 64, Geogr. Gr. Min. 1., Hudson) that Eratosthenes stole it all from his predecessor Timosthenes.

It seems nevertheless to have been regarded only as an approximation; since, when the division of the circle into 360 degrees came into common use, which had already occurred in the time of Hipparchus,* 2000 stades were added to the 250000, for the sake of obtaining a rate in even numbers of 700 stades to the degree. From a similar motive some other geographer thought proper to augment the number to 259200;† by which he obtained a degree of 720 stades, or 12 stades to the minute, which he may have found a still more convenient instrument of calculation.

As the distance between Alexandria and Rhodes, computed by Eratosthenes, was nothing more than an inference from his Egyptian calculation of the perimeter, it follows that the correctness of them both, as well as the rate of 700 stades to the degree, which was deduced from that measure of the perimeter, depended almost entirely upon the truth of the 5000 stades assumed by Eratosthenes as the direct distance between Syene and Alexandria; for as to his mistaken supposition that the two places were under the same meridian, the error arising from it is scarcely to be regarded, if the distance itself be uncertain. Egypt, the reputed parent of geometry, was, above all the countries of the ancient world, that in which we may conceive the existence of maps, from which Eratosthenes may have obtained this important datum.‡ Nothing, however, in proof of such a proficiency in practical geography has yet been found among those monuments, which have given us an insight into almost every part of the customs and social life of the Egyptians; and as they show, when compared with the books of Herodotus relating to Egypt, that the information which he collected in that country was extremely imperfect, we may presume, if not that the Egyptians were never possessed of correct maps of their own country, that the Greeks at least had not been able to avail themselves of that knowledge;§ consequently that the distances in Egypt reported by Herodotus were, like all the other long distances of the Greeks, calculated by converting the time of travelling into stades, according to an assumed rate; and that the 5000 stades of Eratosthenes was nothing more than a computation of the same kind, which, if we may be allowed to judge by the roundness of the number, had no great pretension to accuracy.

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* It appears that this mode of dividing the circle was introduced among the Greeks in the time of the Ptolemies, which favours the opinion that it was Egyptian, and derived from the number of days in the ancient year of that people. (Strab. p. 81.—Diodor. 1, 50.)

† Marcian. Heracl. ap. Geogr. Min. 1, p. 6, Hudson.

‡ Strabo, p. 787. It was the opinion of Freret (Acad. des Insc. xxiv. p. 510) and Gosselin (Traduc. de Strabon, v. p. 314, note 1) that the accurate subdivision of the Egyptian soil, and the measurements repeated after every inundation, had the effect of supplying the Egyptians with the exact dimensions of their country, within a cubit. But however correctly the lands of each nome may have been measured, the combination of the whole into a correct map was almost impossible without trigonometry.

§ While our modern knowledge of Greece tends generally to justify Herodotus, the reverse occurs in regard to Egypt, and shows that he had trusted to those who were unable or unwilling to inform him correctly. An example of this comparative degree of truth in Herodotus is afforded by his remark that the distance of Heliopolis from the sea was 15 stades greater than that of Olympia from Athens, which two places were distant 1485 stades by the road (Herodot. ii. 7). The latter distance was tolerably correct in stades of 600 Greek feet; instead, however, of being equal, it

§ 3. As the ancients had no portable instrument for measuring the portions of a day, and consequently could not easily ascertain the rate of travelling by the hour, a day's journey was their most exact measure of distance, both by sea and land, even as late as the time of Ptolemy the geographer, though comparatively few distances thus reported have reached us, because ancient geographers and historians, aiming at greater precision, have converted the days into stades, and by reporting these, without mentioning the number of days, have generally given us, instead of a fact, the result of an uncertain calculation.

It was naturally in the eastern basin of the Mediterranean, and around Crete, where the naval experience of the Greeks commenced, that they first attained a knowledge of distances approaching to correctness. Homer reports that the Cretans sailed in five days to Egypt,* meaning undoubtedly a continued course with a leading wind, and not farther removed from a direct line, than may have been desirable for the purpose of making a speedy landfall on the African coast. The rate derived from this number of days is the very reasonable one of 62 geographical miles in the twenty-four hours. Five centuries afterwards, the Greeks were still so imperfectly acquainted with the coast of Sicily as to estimate its circumnavigation at eight days, instead of six and a half, which would have been the number according to the proportion furnished by the Cretan ships, or five, at which Strabo rates it in a time when it was almost as well known as it is now. This diminution of the number of computed days, on a coast or route as it became more explored, was founded in reality; for in proportion as experience overcame difficulties or apprehensions,

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bore to the former in direct distance the proportion of 105 to 80, these being the respective lengths of the two lines in geographical miles. But the most remarkable instance in which Herodotus adopted from the Egyptians information obviously false, is his description of two pyramids in Lake Mœris, which he states to have been a stade in height, or 160 feet higher than the great pyramid of Ghizeh, and half covered by the waters of the lake. Strabo remarks that the Egyptian priests, whom he styles barbarians, resisted all the efforts of Plato and Eudoxus to obtain a communication of their knowledge. It may be thought, perhaps, that although denied to Eudoxus and no longer existing in the time of Strabo, it may have been accessible to the Ptolemies; but though the Greeks then derived some assistance from the astronomy of Egypt, they seem to have obtained little or nothing from their geometry.

* Il.

the undertaking would be performed in a smaller number of days. But even after the computed days had been reduced to the smallest number, persons who travelled the route for the first time would often imagine that they passed over a greater distance in the day than was true; and thus arose an exaggerated rate of the day's journey, which was reduced as the seas or countries became better known, though it never, except in some rare exceptions, reached the true rate of the Greek stade of six hundred feet, or six hundred to the degree, because the Greek geographers, following the authority of Eratosthenes, had agreed in considering seven hundred as the right proportion.

Herodotus has left us the most remarkable example of an exaggerated computation of stades to the day's sail, in his description of the dimensions of the Pontus or Black Sea. The length of this sea, from the Bosphorus to the Phasis, he states to have been, in time, nine days and eight nights.[*] This, when measured by the Homeric rate of the Cretan ships, is in just proportion to the reality: but when Herodotus converts his summer day's sail into seven hundred stades, and his night's into six hundred,[†] making a total in the twenty-four hours of thirteen hundred stades, we are under the necessity of inferring, either an extreme exaggeration in the number of stades, or that by these stades he intended a measure of less than half the length of the Greek stade. It is evident, however, that his estimate of a day's or night's sail in the Pontus is nothing more than an extravagant conjecture of his own, caused probably by his exaggerated idea of the magnitude of this, which he describes as the most wonderful of all seas (*πελαγέων ἁπάντων θαυμασιώτατος*) ; for admitting, contrary to all probability, that in other parts of his work he may not always have employed the stade, which, without the smallest hint of the existence of any other, he has defined as consisting of six hundred Greek feet, it is impossible to suppose that he could in the same breath have intended two different measures, without distinguishing them. And yet this supposition would be necessary, since in the same passage in which he describes the length of the Pontus in a number of stades, giving a rate of between twelve and thirteen hundred to the degree, we find that the length and breadth of the Bosphorus and Hellespont, places intimately known to the Greeks, and which the eye could measure, are accurately stated by him in stades of six hundred Greek feet: namely, the Bosphorus as one hundred and twenty stades long and four broad (of course in the narrowest part), and the Hellespont as four hundred stades long and seven broad. It is clear, therefore, that in this instance Herodotus allowed an excessive number of stades to the day's sail on the less frequented route, and accurately estimated the measure of the known places. In like manner, the length of the Propontis, which was better known in the time of Herodotus than the Pontus, but not so well as the Bosphorus and Hellespont, he states to have been 1400 stades, which gives a rate of 840 stades to the degree, or two-thirds of that which results from his length of the Pontus, and about the medium between the latter and that of the Bosphorus. Thus also in the unexplored coasts of the Persian Gulf and Indian Ocean we may remark that the stades of Nearchus are as short as those of Herodotus in the Pontus, until he obtains a pilot, after which the day's sail gives a longer stade.*

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[*] Herodot. iv. 86.

[†] Id. iv. 85.

By a similar effect we find that, in all those parts of the ancient world which were best known to the Greeks, the rate of seven hundred stades to the degree is, in general, that most applicable to their reported distances. These, however, were direct lines, reduced from itinerary computations, and we know by modern experience how generally it happens in such cases, that the diminution is insufficient: we may conclude, therefore, that in truth no other than the stade of 600 Greek feet was intended by the ancient computors. The more frequented the route, the more populous the country through which it passed, the more civilized and lettered the people, the more nearly we find the reported distance to approach that standard of the stade. Thus according to Herodotus, the road distance from Athens to Olympia was 1485 stades,† giving a rate of 13½ stades to the geographical mile, when measured with intervals of 5 geographical miles in the compasses along the course of the road. The road distance from Ephesus to Sardes, according to the same historian, was 540 stades,‡ which, when measured on the map in the same manner, gives a rate of between 11 and 12 stades to the geographical mile. But this difference of rate may be accounted for by the circuitous nature of the former route; by its having crossed several ridges of mountains, and partly perhaps because, in the time of Herodotus, it may have been less correctly known than that from Ephesus to Sardes. There can be no question, therefore, that in both instances the historian intended the same stade, which he has elsewhere defined as consisting of 600 Greek feet.

The same result is produced on a much longer line of road, that from Sardes to Susa, the road distance between these places, 13,500 stades,§ giving, when measured on the modern map along the course of the road, with intervals of half a degree in the compasses, a rate of something less than 12 stades to the geographical mile. And this may be considered as one of the most authentic road distances in the ancient world, the road having undergone a kind of measurement, for it had been divided into στάθμοι, or stations, resembling the Roman mansiones, at which buildings were erected for the convenience of travellers; it appears even that the intervals between the stations had been computed with some care, since, as we learn from Herodotus, who has entered into details regarding this road, the stations were not always at equal distances, having doubtless been fixed at longer or shorter intervals as the nature of the country required. The truth of his description is confirmed by the near approach to correctness in the proportions of the different parts of the route to the whole, when measured on the modern map, and proves, upon the whole, that in this remarkable instance the stade of 600 Greek feet was certainly intended by the historian.[*]

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* Vincent's Commerce and Navigation of the Ancients in the Indian Ocean, i. p. 229.

† Herodot. ii. 7. ‡ Id. v. 54. § Id. v. 52.

§ 4. With these considerations in view we may now examine the perimeter by Eratosthenes, and that computation of 5000 stades of direct distance between Syene and Alexandria, upon which he founded his calculation. In the absence of trigonometry this distance could only have been obtained from itinerary estimates by some rule of reduction, which was inevitably more or less liable to inaccuracy. The itinerary distances may have been computed by land or by water; the difference could not have been great on the whole length of Egypt, as the windings of the valley follow those of the river. By Herodotus the whole distance from the sea to Syene is reckoned at 7920 stades. On my own map of Egypt, the scale of which is 6 inches to the degree, the length of the river up to Syene, measured along the line of navigation, with intervals of 4 miles in the compasses, is about 600 geographical miles. The computation of Herodotus therefore gives about 800 stades to the degree. Three or four centuries later, however, when the Nile had become one of the best-known and most-frequented roads in the ancient world, Aristocreon reckoned the same distance to be no more than 6000 stades;[†] and his computation agrees perfectly in proportion with that of Artemidorus, who reckoned the distance from the head of the Delta to Syene to have been 4800 stades, and equal to that from Syene to Meroë, which equality is confirmed by modern observation. The numbers of Artemidorus accord also with the aggregate of distances on the route by land in the Antonine Itinerary from Heliopolis to Syene;

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[*] This valuable passage is defective in one place, and there is an evident loss of some words, the number of stations in the Matiene being too small, and the parasangs being entirely omitted; which renders it impossible to compare the proportions of this part of the route with the map. De la Barre has ingeniously supplied some words which would make the passage complete and consistent.—*Mém. de l'Acad. des Inscriptions*, viii. p. 341.

[†] Ap. Plin. H. N. 5. 9 (10).

namely, 596 M. P., equal to 4768 stades. Here, therefore, we have the clearest proof that, as the experience of the Greeks increased, the computation shortened; and at length was obtained with tolerable correctness in the true Greek stade of 600 to the degree. As Eratosthenes lived much nearer to the time of Artemidorus than to that of Herodotus, it is not improbable that his estimate of the itinerary distance from which the direct distance of 5000 was reduced may have been nearer to the correct number of Artemidorus than to the excessive valuation of Herodotus. But, however near it may have been to the former, still it is evident that there required only too high an estimate of the navigation, or too small a diminution in calculating the direct distance (and both might possibly combine), to increase the measure of the arc from 453 geographical miles, its true length on the modern map, equivalent to about 4500 stades of 600 to the degree, to the 5000 of Eratosthenes. And thus we have a strong argument that all ancient computations of distance were more or less faulty; that, with the increasing knowledge and experience of the Greeks in seas and coasts, or in routes by land and water, they more nearly approached the truth; and that neither Eratosthenes nor any other Greek geographer ever had in mind any other but the true stade of 600 Greek feet, however erroneous their computations of distance in that stade may be found on comparing them with the modern map.

When the pacification of the world under Augustus gave a degree of security to the countries forming the Roman empire, which they had never before enjoyed, the paths of commerce and social communication became more frequented, and the distances of places more correctly known. We find accordingly that all those reported in stades by the most trustworthy authorities of the first and second centuries of our era favour the belief that they intended no other than the true stade of 600 to the degree. In the Black Sea, in place of the exaggerated estimate of Herodotus, we now find that its diameter from Byzantium to Panticapæum, as well as the medium of four or five different computations of its circumference as reported by Pliny, give a rate not much greater than 600 to the degree. And if we refer to Pausanias, who, from his diligence and the nature of his pursuits, is more worthy than any other author of being consulted on this question, it will appear that, although some of his numerous distances are doubtless incorrect, either by the fault of the author or his transcribers, they are evidently in general calculated in the same stade which six centuries before his time was defined by Herodotus as consisting of 600 Greek feet, and which generally produces a rate of 10 stades to the geographical mile in short, and of 12 or 13 in long distances. Of the latter there are not many in Pausanias, but I may refer to that from Sparta to Olympia as being one of the most likely to have been measured and well known. These two places he states to have been 660 stades distant by the road, which gives a rate to the geographical mile on the line of road of 12½ stades, the direct distance being 53 geographical miles.[*] Another proof that the Attic standard of the foot, and consequently of the stade, was uniform in Greece Proper and its colonies, even at a late period, is afforded by Hyginus, who informs us that the Cyrenaic foot bore to the Roman the proportion of 25 to 24,[†] being exactly the same as that of the Attic foot to the Roman.

If the origin and real nature of the varying calculations of the circumference of the earth were such as I have endeavoured to prove, it is obvious that the stades of different lengths deduced from them are quite visionary. It would be superfluous, therefore, to enter into any detailed exposition of the system which endeavours to reconcile ancient computations of distance with the truth, by applying to them, according to the necessity of the case, stades of 1111⅑, or of 883⅓, or of 666⅔, or of 500, or any other proportion to the degree; a system which has been carried so far that the same ancient writer has been supposed to have reported the length of a country in one kind of stade, and the breadth in another. Even if such an hypothesis were well founded it would prove too much. Correctness in distances, or even in proportions of distance between the principal points of a map, the most simple and certain test of its truth, could not possibly have been attained by the ancients, unaided as they were by the compass or by observations of longitude, and possessing no means of measuring an horizontal angle. In fact, when we come to examine their geographical proficiency, we find it in exact proportion to the poverty of their geometrical means.

In the eastern portion of the Mediterranean and the countries around it, their information, as before hinted, more nearly approached the truth than in any other part of the world. Eratosthenes knew that the general direction of the valley of Egypt, when produced, would describe that of the western coast of Asia Minor:[‡] he knew that Mesopotamia was shaped liked a boat,[§] and he was better acquainted than we have been, until recently, with the course of the Nile through Nubia.[||] By limiting the

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[*] The two distances reported by Pliny, from Sicyon to Elis 1200 stades, and from Athens to Sparta 440, are totally inconsistent and inaccurate; as the former would require a rate of more than 16 stades to the geographical mile, the latter less than 6.

[†] Hyginus de limitibus constituendis, ap. rei agrariæ scriptores, Goes, p. 210.

[‡] Eratosth. ap. Strabon., p. 114.

[§] Id. ibid., p. 79, 80.

[||] Id. ibid., p. 786. The remarkable bend of the Nile in Nubia here described by Eratosthenes was first verified in modern times by the information procured by Burckhardt. See his Travels in Nubia, p. 451.

οἰκουμένη or inhabited earth to about one-fourth of the northern hemisphere, the length of which was included between the Sacred Cape of Iberia (St. Vincent) and the mouth of the Ganges, and the breadth from about 12° N. of the equator to Thule, and by supposing the whole of this land to be surrounded by the Atlantic Ocean, he was enabled to anticipate Vasco da Gama in imagining the possibility of circumnavigating Africa, and Columbus in supposing that India might be reached by sailing westward from the coast of Iberia, if, as Eratosthenes adds, the great extent of the Atlantic Sea were not an obstacle.*

The degree of accuracy, however, to be attributed to his positions in general may be estimated by the points which he places in the same latitude with Rhodes, on the line which a century before his time, and much more anciently, had been assumed as the *διάφραγμα τῆς οἰκουμένης* or central line in the length of the world:† these points were the Sacred Promontory of Iberia, the Columns of Hercules or Straits of Gibraltar, the Sicilian Straits, Capes Tænarus and Sunium in Greece, Issus, and the Caspian Gates.‡ Of these, Sunium is 1° and the Sicilian Straits near 2° to the north of the latitude of Rhodes. On the central meridian, or that which at Rhodes cuts the diaphragma at right angles, he placed Meroë, Syene, Alexandria, Byzantium, and the Borysthenes,§ not one of which is on the same meridian as Rhodes, though Byzantium is not far from it. As well as Hipparchus he followed Pytheas in placing Massilia and Byzantium in the same latitude,‖ and he imagined Carthage, the Sicilian Straits, and Rome, to have been under one and the same meridian.¶ The distance between Sicily and the Peloponnesus he made almost as great as that between Sicily and the Straits of Gibraltar;** and the breadth of Northern Greece from Dyrrhachium to Thessalonica between a third and a fourth of that of Asia Minor,†† instead of a half. It was scarcely possible to expect any correct distances upon a map so constructed, unless by the effect of a compensation of errors; and accordingly we find that such a compensation had considerable effect in causing the length of the Mediterranean to approach its true proportion: for, the coast of Asia Minor between Rhodes and Issus having been tolerably well known to navigators, the excess of distance between Rhodes and Sicily counterbalanced in great measure the defect of that between the Sicilian and Iberian Straits, so that the whole length of the Mediterranean, when measured by the stade of 700 to the degree of the equator, is found to be not more than a sixth or a fifth below the 30,000 stades, or thereabouts, which Eratosthenes ascribed to it.* Gosselin, however, viewed this measure of the Mediterranean in a very different light, both in itself and as a portion of the entire line from the Sacred Cape to the mouth of the Ganges. Finding that the true interval between the two extreme points is 100° of longitude, and that 70,000 stades, the length attributed to the entire line by Eratosthenes, gives exactly his rate of 700 stades to the degree, Gosselin concluded that such a coincidence could only have arisen from a true map, on which the degrees of longitude had been marked without any distinction of their diminished breadth, and that from these Eratosthenes had deduced his distances, ignorantly converting them into stades of 700 to the degree of latitude. In this opinion Gosselin was confirmed by observing that the distance given by Eratosthenes between the Sacred Cape and Issus, when reduced in the proportion of the length of a degree of longitude, in the latitude of Rhodes, would give accurately the length of the Mediterranean to within a few miles;† and the result appeared the more wonderful, as so late as the year 1768 the length of the Mediterranean was so little known that in the best modern maps it was made more than one-third greater than the reality. Combining this hypothesis therefore with the fact that Pytheas had some knowledge of a promontory, Calbium, which lay beyond the Sacred Cape of Iberia, and corresponded to Cape Finisterre of Brittany,—of an island, Baltia (Denmark or Scandinavia), which has given name to the Baltic Sea, and that he had even some idea of the position and extent of the British islands, and of the existence of Thule, places which Pytheas could not have visited in his pretended travels, Gosselin concluded that both Pytheas and Eratosthenes had had access to the memoirs of some unknown ancient people to whom Europe and its seas were as well known as it is to ourselves. He shows that this people could not have been the Babylonians, or the Phœnicians, or the Carthaginians, or the Egyptians; and Bailly, who in his 'History of Astronomy' entertains a similar opinion, supposes them to have lived before the deluge.‡

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* Eratosth. ap. Strabon., p. 64.

† Dicæarch. ap. Agathem. Geogr. I. 1, p. 4.—Geogr. Gr. Min. Hudson, II.

‡ Eratosth. ap. Strabon., p 64. § Id. ibid., p. 62.

‖ Ap. Strab., p. 63, 71, 115. ¶ Eratosth. ap. Strab., p. 93.

** See Gosselin, Géog. des Grecs., anal., p. 14-20; and the map entitled Eratosthenis Systema Geographicum.

†† Eratosth. ap. Strab., p. 68, 106.

§ 5. The practical astronomy and the geometry of the ancients having continued almost stationary after the age of Eratosthenes and Hipparchus, their subsequent progress in geography was little more than the result of the knowledge, gradually acquired, of all the countries which surrounded Rome as a centre. Without trigonometry, or any accurate method of determining longitudes, the only mode of approximating to a correct construction was by measurements and computations of distance, assisted by latitudes. Strabo and Pliny, by the numerous distances which they have given, have afforded an unconscious acknowledgment of this principle; and it is only from those distances that we can estimate the proficiency of the men of their time in tabular geography. In the year 122 B.C., the Romans commenced a series of real measurements, by the erection of milestones on their roads,* which, when it had been continued for two centuries on every great road of the empire, may, when checked by differences of latitude, have given them the means of forming an imperial map far more accurate in its general construction than had ever been in the power of the Greeks. The commission instituted at Rome by the great reformer of the calendar, in the year 44 B.C., and which for twenty-five years continued its active operations throughout the Roman world,† under the inspection of Agrippa and patronage of Augustus, produced about the end of that time a great painting or map, which was displayed in the portico of Agrippa.‡ Strabo, however, who wrote about that time, appears to have derived little advantage from these geographical acquirements of the Romans. But Strabo, as a geographer, was ignorant and negligent, as well as absurdly systematic. His work is extremely valuable with a reference to history; and from his criticisms of Eratosthenes and Hipparchus we derive the greatest part of our knowledge of Greek geography: but he was himself very deficient in the mathematical science of his time, and instead of improving, like geographers in general, upon his predecessors, he appears even to have neglected the opportunity which a long residence at Alexandria§ afforded him of acquiring as much as had long been known to that school. Of bearings and the relative positions of places and the forms of countries, his conceptions are often, for so extensive a traveller, surprisingly false, and can only be accounted for by his having had no capacity or taste for scientific geography. Not unfrequently he makes contradictory assertions as to the same place and country; and, upon the whole, we may say that although geography was much indebted to his labours as a traveller, the science in other respects degenerated in his hands. His system of the οἰκουμένη, or habitable earth, surrounded by one great sea, of which the Caspian was a gulf, like those of Arabia and Persia, was the same as that of Eratosthenes. The length of this habitable earth, he agreed, with some preceding geographers, in supposing to be something more than double its breadth;* one of those unproved assumptions so detrimental to the progress of truth, into which the ancients were led by some favourite theories of proportion, and which Strabo, with all his reputed philosophy, seems never to have doubted, or thought of examining.†

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* Eratosth. ap. Strabon., p. 87.—See Gosselin, Géogr. des Grecs. anal., p. 12, et seq.

† Ibid., p. 41.

‡ Bailly, Hist. de l'Astron. Anc., I. 3.

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* Plutarch. in C. Grac. 7.

† Æthic. Cosmog. præf.

‡ Plin. H. N. iii. c. 2.

§ Strab. p. 101.

A more correct basin of the Mediterranean was the principal improvement of Strabo on his Greek master; but by placing Marseilles 2400 stades, or about 13½° to the south of Byzantium, instead of 2° 17′ to the north, which is its real position, he committed an error greater than that of Eratosthenes, and so mischievous in its effects, that it distorted the whole of Europe. Even the British islands were better known to Eratosthenes than to Strabo, who supposed the British Channel to extend nearly to the Pyrenees, and that Ireland, scarcely habitable on account of cold, and peopled only by a few savages, was situated 4000 stades due north of the centre of Albion.‡ It was one of the curious consequences of his false principles, that he conceived the Pyrenees, the Garonne, the Loire, the Seine, and the Rhone, to have formed nearly parallel lines from south to north.

Pliny, who wrote thirty or forty years later than Strabo, but who appears to have been unacquainted with his work, though he consulted almost every other Greek geographer known to us, had the advantage of drawing from all the sources of which the streams centred in Rome; where he had not neglected the portico of Agrippa, for he often cites the authority of that illustrious Roman, and sometimes dissents from it. Pliny has left us between 500 and 600 distances, which, when compared with those of Strabo, bear strong marks of geographical improvement; although, as might be expected in an inquiry which forms only a small part of the laborious researches of the author, it is necessary to reject a portion of those distances as manifestly faulty, either in consequence of defects of the text, or of original error. Visionary theory and a wish to discover proportions in the works of nature, still continued to obstruct the march of practical truth; for Pliny, the most learned Roman of the most learned age of Rome, remarks as follows: "Europe appears to be greater than Asia by a little less than a half of Asia; and greater than Africa by the same quantity added to a sixth part of Africa. Europe is a third part of the whole earth with the addition of a little more than an eighth. Asia is a fourth *plus* a fourteenth, and Africa a sixth *plus* a sixtieth."

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* Strabo, p. 64.

† The following is his singular mode of reasoning:—"It is confessed," he says, "by both ancients and moderns that the habitable earth is twice as long as it is broad. Eratosthenes, therefore, having extended the breadth from Jerne to Thule, a portion uninhabitable on account of the cold, was obliged, in order to preserve the aforesaid proportion, to give an undue extent to its length from the western cape of Iberia to the eastern extremity of India." (Strabo, p. 64.)

‡ Strabo, pp. 72 and 201.

Great accessions were made to geography during the century which elapsed between the dates of Pliny and Ptolemy, though still without any improvement in the scientific means of methodizing those acquisitions. To the knowledge of their own country by the Greeks; to the discoveries produced by the conquests of Alexander; to the observations of his naval commanders and engineers; to the measurements of his σταθμοδοταὶ and ϐηματίσται; to the subsequent conquests of Seleucus Nicator and Antiochus Soter; to the military surveys, itineraries, and measured roads of the Romans, which had been accumulating during four or five centuries of conquest and dominion, were now added the effects of commerce and social communication during two centuries of peace and prosperity. The consequent acquisitions to geography are sufficiently evident from the work of Ptolemy, particularly from those parts of it which relate to countries the least known to Roman geographers, such as Africa, the northern parts of Asia and Europe, and from none more than the British islands. These had already, as Pliny remarks, been made known, during thirty years before his time of writing, by the Roman commanders; and it is doubtless to the commerce of the Romans and Romanized Britons with Ireland, during the two preceding centuries of the Roman sway in Britain, and not to any Carthaginian or Phœnician materials obtained by Ptolemy (as Irish antiquaries delight in persuading themselves) that we are to attribute the knowledge of Ireland, shown in the work of Ptolemy, and of some existing names, such as the river Ovoca and the city Eblana.*

A preference of system to the collection of facts—that besetting vice of philosophers of all ages and in every branch of science—continued, however, to distinguish the Greeks to the latest period of geographical improvement; and hence Ptolemy, instead of obtaining for geography the advantages which might have been derived from a selection and verification of distances, and from a combination of them upon sound principles, applied the whole of his collected information to a system, which was founded in ignorance and error. The method which he followed had been long before recommended by Posidonius and Hipparchus, and doubtless it is the most scientific; but as very little improvement had been made in astronomical geography since the time of Thales, we are not surprised that Ptolemy failed in a system which is adapted only to geography in its most advanced state, and which consequently had the effect of misleading himself, as well as those who relied upon his authority. Like geographers in general, he converted the labours of his immediate predecessor to his own use, and endeavoured to improve upon them. But in blaming that predecessor, Marinus of Tyre, for having separated facts from systematic arrangement, he leaves on us the impression that it would have been better for us to have lost his own meagre tables than the work of Marinus, which, as he thus gives us reason to believe, contained, together with the development of his method, many important facts and simple results of experience not yet tortured into an erroneous system. The latitudes of Ptolemy are too often wide of the truth, to allow us to believe that they were derived from gnomonic observation; as well as the longitudes, therefore, they were for the most part calculated from distances, very few of which had been measured. And hence in general it may be said, that, excepting the information sometimes derived as to the relative situation of places by means of the differences in latitude or longitude, the utility of the work of Ptolemy consists chiefly in its catalogue of ancient names chorographically arranged.

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* As many additions were made to the work of Ptolemy long after his time, the Irish chapter may not have escaped the same corruption. Marinus says [ap. Ptolem. i. 11] "that Philemon reported the breadth of Ireland from east to west to be 20 days; but that Philemon derived this information not from his own observation, but from certain merchants, more intent probably upon their own affairs than on geographical enquiries." This passage seems to point out at once the source of Ptolemy's knowledge of Ireland, and the cause of its imperfection.

The great errors of Marinus and Ptolemy appear to have arisen chiefly from the want of instruments for the correct observation of time, whence, although they understood how to deduce differences of longitude from eclipses and other celestial phenomena, they were scarcely ever able to obtain observations of that kind with sufficient precision for geographical purposes, but on the contrary appear often to have been misled by them into a confirmation of errors in excess, originating in itineraries not sufficiently reduced into direct distance. Ptolemy himself was well aware of the prevalence of the latter cause of error, and has unconsciously given a remarkable instance of the former in his difference of longitude between Arbela and Carthage, which he has placed at an interval of 45° of longitude, because an eclipse of the moon was reported to have happened three hours earlier at the former than at the latter.* The real difference, however, is not more than 33°, so that the observers made an error in excess of forty-eight minutes of time. Instead of about 75° of longitude between Cape St. Vincent and the mouth of the Indus, Ptolemy allows 110°; † and as a portion of this enormous error, he makes the distance from the Iberian promontory to Issus 67° instead of 41°.‡ The distance in stades had at the same time, in the progress of practical experience, been approaching to the truth; the 30,000 stades of Eratosthenes having been reduced by Agrippa to 27,600.* This number, indeed, still exceeded the true distance by five or six thousand stades of 600 Greek feet; but such an excess might easily occur in the computation of a distance which the ancients had no means of correctly measuring, and which, in fact, was nearer to the truth by a half than that which the moderns, with all their advantages, had obtained seventy years ago.† It appears, therefore, that Marinus, trusting to his differences of longitude in hours or degrees, was under the necessity of rejecting either the received computation of the length of the Mediterranean, or the rate of 700 stades to the degree, and that he chose the latter, accommodating the length of the Mediterranean in stades to his degrees of longitude, by supposing a rate of 500 stades to the degree of latitude, and of 400 to the degree of longitude in the parallel of Rhodes; for this rate multiplied by 67 will give 26,800 stades for that distance, differing only 1800 stades from the computation of Agrippa.

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* Ptolem. i. 4.

† Ibid. ii. 5; vii. 1.

‡ Ibid. i. 12; ii. 5; v. 8.

That such was the process of Marinus, followed by Ptolemy, and not a blind adoption of the second computation of Posidonius, which equally gave a rate of 500 stades to the degree of latitude, seems evident from the fact that Ptolemy was aware of the error of Posidonius, as well as of Eratosthenes, in placing Alexandria and Rhodes on the same meridian; for the tables of Ptolemy mark a difference of 2° 10′ in their longitude, or not more than 20′ less than the truth.‡ In reference to the main question, therefore, of the present memoir, that of the singleness of the stade, there is nothing adverse to that hypothesis in the proportion of the stade to the degree, as employed by Marinus and Ptolemy.

Notwithstanding the imperfection of the work of Ptolemy, it may be considered as the extreme limit to which ancient geography ever attained, and it continued to be the chief, or rather the only, guide of Greeks, Arabs, and every other people, until long after the revival of learning. The many additions and alterations, which the text evidently received in the course of transcription, cannot increase our confidence in a document which from its nature is of such questionable authority, and it is therefore seldom to be relied on, unless when confirmed or illustrated by collateral evidence.

§ 7. If we reject the variety of stades derived from the Greek computations of the perimeter of the earth, as void of any foundation in reality; if we consider that, from the time of Herodotus to the end of the second century of the Christian era, there is no direct testimony to the existence of any metrical stade of a different standard from that of 600 Greek feet; that Polybius, Strabo, Dionysius of Halicarnassus, Appian, Livy, Vitruvius, Columella, Pliny, Frontinus, Marcian of Heracleia,[*] all confirm that measure by valuing the stade at one-eighth of the Roman mile, we cannot fail to conclude that historians and geographers constantly intended this stade, and no other, in their statements of distance, however erroneous may be the computations reported by them when referred to this measure. Is it possible that Eratosthenes, Posidonius, Hipparchus, Strabo, Pliny, Ptolemy, and Marcian of Heracleia, when examining and criticising former measures, or endeavouring to discover the causes of the disagreement of authors in particular distances, should not have adverted to the variety of stades had it existed? Or were they ignorant of the fact? Gosselin, who believed in this ignorance, as well as in the existence of six different stades, might well exclaim, " Cette ignorance, que toute l'Ecole d'Alexandrie et tous les géographes de l'antiquité paroissent avoir partagée, est assurément une des choses les plus remarquables et plus étonnantes que puisse présenter l'histoire de la géographie ancienne."[†]

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* Plin. H. N. *ut supra.*

† Gosselin remarks, that in the year 1768 the maps of Samson, the best then known, gave a length of the Mediterranean more than a third greater than the reality.

‡ Ptolem. iv. 5; v. 2.

In Greece Proper the stade, as we have seen from Pausanias, retained its true length until the end of the second century, and probably as much longer as the maintenance of the Olympiads and of the four Sacred Games secured the preservation of its standard in the Stadium. In every other part of the Roman world, where reverence for Greek customs and the imitation of them were rapidly passing away, when the true standard of the stade was of little importance or interest, this neglect would naturally be followed by uncertainty as to its length. It is not surprising, therefore, to find that, in the course of the three following centuries, the mile is represented by some writers to have been equal to 7½ stades, and by others to 10 stades,[‡] until at length it appears to have been applied to various measures of distance, without any reference to its origin.[§]

The author of those times, who, by the general character of his work, lends the greatest weight to the belief of a real variety of stades, is Censorinus: he distinguishes three stades; namely, the Italic of 625 feet, the Olympic of 600 feet; and the Pythic of 1000 feet.* As Censorinus makes no distinction between Roman and Greek feet, we are to infer, notwithstanding the Greek names, that Roman feet alone were intended by him; and this is confirmed by his Italic stade, which, having consisted of 625 feet, was evidently no other than the Greek stade in Roman feet. His Olympic, therefore, was the Roman stade of 8⅓ to the Roman mile, or, in other words, a measure of 600 Roman feet; and the three can only be regarded, supposing Censorinus to have been correct, as Italian measures of the third century, to two of which the Romans had been pleased to attach Greek names, and to the third, or Italic, a name which may be described as the reverse of that really belonging to it, since it was, in fact, the Greek stade. Considering, indeed, the origin and use of the stade in Greece, and the evidence of the Stadia still extant, it is impossible to believe that any such measures as the Olympic and Pythic stades of Censorinus were ever employed in Greece. We may be assured, at least, that the Pythic stade was not taken from the Stadium of Delphi, which is still sufficiently preserved to show that it differed not in length from the other Stadia of Greece. It is possible, however, that 1000 feet may have been the length of the curriculum of the Pythic *Hippodrome*.

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[*] See above, p. 2, note §.

[†] Géogr. de Strabon, i. p. 182, note 1.

[‡] Dion Cassius (52, 21) describes a distance known to have been 100 Roman miles as 750 stades, and this we find stated to have been the proportion of the stade to the mile by some of the grammarians (Suidas and Photius in Στάδιον. See also Julian of Ascalon ap. Harmenop. Promptuar. tit. 4). And yet the Jerusalem Itinerary says, Stadia mille quod facit millia centum (Wesseling, p. 609); and a similar proportion may be deduced from the average rate of the peripli, or stadiasmi, when compared with the truth.

[§] See Mémoires de l'Académie des Inscriptions, iv. p. 292; xxxi. p. 295.

With the extinction of paganism in Greece, or soon afterwards, the stade probably ceased to be employed, in that country, as a Greek measure. The use of the mile, like many Roman customs adopted by the Greeks, has continued to the present day, not, however, as a distance consisting of any determinate number of the still-existing national measures of feet, cubits, or fathoms (ποδάρια, πηχεῖς, ὀργυιαὶ), but merely as a computation, which, as common in such cases, has fallen below the real standard. The diminution began, probably, with the neglect of the Roman roads and the destruction of the milestones.

§ 8. It may still remain due to the great name of Rennell to advert to the conclusion at which he arrived in examining this question, and which nearly concurred with that of Delabarre; namely, that there were two stades, the one of 600 Greek feet, the other considerably shorter.† Having observed that the distances given by eight different authors, of whom the oldest was

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* Nam et Eratosthenes geometricâ ratione collegit maximum terræ circuitum esse stadiorum CCLII millium: ita Pythagoras quot stadia inter terram et singulas stellas essent indicavit. Stadium autem in hac mundi mensurâ id potissimum intelligendum est, quod Italicum vocant pedum DCXXV, nam sunt præterea longitudine discrepantia ut Olympicum quod est pedum DC, item Pythicum pedum CIↃ.—Censorin. de die nat. 13.

† Geography of Herodotus, section 2.

Herodotus, and the latest Arrian, varied only a fourteenth in the length of the stade, as resulting from a comparison of those distances with the reality,—the longest being the 696th, the shortest the 750th part of a degree of the great circle,—Rennell justly thought that such a difference in computed distances might easily have been the result of inaccuracy. But observing, also, that all these rates were below that of 600 Greek feet to the degree, he inferred that, besides that measure which belonged to the stadium or place of gymnastic exercise, there was a shorter measure for itinerary purposes, which he deduced from the average of the several rates just alluded to, and reckoned at the rate of 718 to the degree. It has been argued that, unless a much shorter stade than that of 600 Greek feet existed, it was impossible that marches of from 150 to 200 stades could have been customary, as they appear to have been, particularly from Xenophon. The distances of Xenophon, however, were not in stades, but in computed parasangs, presumed to be of 30 stades each; they were computations, therefore, similar to those of hours in the present day, when made by those who are not in possession of watches. Pliny, an author not very scrupulous as to accuracy, complains of the uncertainty of the parasang. We know that the Romans often marched 20 M. P., or 160 stades of 8 to the mile, and sometimes 24 M. P., or 192 stades, in 5 hours of summer, or 6 of equinoctial time.* There is greater weight, therefore, in the remark of Rennell that, had the stade of 600 Greek feet been used as the itinerary measure of the Greeks, "the examples could not uniformly have given a standard short of it, as is found to be the case."† To this we may reply, that such an itinerary stade was either a measure of 513½ Greek feet, or it consisted of 600 feet, which feet were equal to about 10 inches English; both inadmissible suppositions: the first because all evidence opposes the belief that the word stade was ever applied by the Greeks to any other number of their feet than 600; while, in the latter alternative, the 600th part of the measure would have been too short for any foot.

This itinerary stade, therefore, is a mere inference from a comparison of ancient computations with real distances, unsupported even by a nominal standard. Such a measure is a mere conjecture, a computed measurement, varying with the knowledge and accuracy of the writer, or the skill, in the computation of distances, of himself or of those from whom his information was derived: it was less precise, in short, than the computed itinerary hours of modern orientals. It is not surprising that distances so reckoned should almost constantly have given a stade below the true standard. In like manner, we find that the numerous distances stated in Roman miles by Pliny, although preserving in general a more just proportion to one another than those reported by any other author, are, with the exception of such as are evidently erroneous, almost invariably above the reality. The same observation is applicable also, though naturally not in so great a degree, to the ancient documents which are strictly topographical, such as the itineraries, peripli, and stadiasmi; and it arose from the same cause, namely, that the far greatest proportion of distances inserted therein are not measurements, but computations. Hence those documents are full of original errors, as well as of such as have arisen from a repetition of copies in the course of ages. It happens, moreover, most unfortunately, that our itineraries of Roman roads, a complete and accurate collection of which would have supplied a series of true measurements on all the most important lines in the ancient world, are of a late date, and obviously incomplete as well as incorrect.

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* Plin. H. N. 6, 25 (30).

† Geogr. of Herodotus, sect. 2.

These and other preceding observations are not intended to support an opinion that the distances reported in ancient history are generally unworthy of the notice of the investigator of ancient geography. On the contrary, they furnish some of his most valuable materials: always, however, to be examined with suspicious criticism, and to be corroborated, if possible, by other testimony, but not to be adjusted by a varying scale of stades derived from a supposed measurement of the globe by some unknown ancient people: for if geology agrees with sacred history in showing that man has not long been an inhabitant of this planet, geographical inquiry equally tends to the persuasion that his goodly freehold has never yet been surveyed; though the present age has made some advances in this useful undertaking, and the Royal Geographical Society will, it is hoped, continue that successful progress, which has already merited the applause of all who feel an interest in science.